

EPIDEMIOLOGY OF BRUCELLOSIS IN AL MEDINA REGION, SAUDI ARABIA

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أهداف الدراسة: تهدف هذه الدراسة إلى معرفة معدل انتشار الإصابة بمرض الحمى المالطية في منطقة المدينة المنورة ومعرفة الأسباب التي لها علاقة بذلك.

طريقة الدراسة: تم استخدام المنهج الوصفي على عينة البحث البالغة (500 منزل) 4000 شخصاً في عام 1997م، وتم اختيارهم من مدن وقرى وهجر منطقة المدينة المنورة بالطريقة العشوائية وتمت مقابلة جميع الأفراد وسحبت منهم عينات من الدم وتم تحليلها مخبرياً.

نتائج الدراسة: أشارت النتائج إلى أن نسبة انتشار المرض 2.6% وكانت النسبة تزداد بازدياد العمر وكانت أكثر انتشاراً في الريف وبين الفئات ذات المستوى الاجتماعي المنخفض. كما أن هناك عدة عوامل مترابطة مع وجود الحمى المالطية عند الإنسان وهي: استهلاك الحليب الغير مبستر ومشتقات الحليب، تربية الحيوانات وحلبها، ملامسة الحيوانات وخاصة الوالدة منها، ملامسة المشيمة، تقطيع اللحم، كما أشارت النتائج على أن نسبة الانتشار بالمرض بالنسبة للحيوانات هو 17.4%.

الاستنتاجات: على ضوء نتائج الدراسة يتضح أن نسبة الإصابة بمرض الحمى المالطية في المملكة عال، وللتحكم في انتشار هذا المرض لابد من تبني أسلوب صحي شامل تتكامل فيه الأنشطة والوسائل الوقائية.

التوصيات: في ضوء هذه النتائج المستخلصة نوصي بتوجيه الاهتمام للتعاون بين مختلف القطاعات الحكومية للاهتمام والتعرف على المشكلات الصحية بالنسبة لمرضى الحمى المالطية، التوعية الصحية، الاستقصاء الوبائي، والتطبيق الصحي السليم لتربية الحيوانات.

الكلمات المرجعية: معدل الانتشار، الحمى المالطية، المدينة المنورة.

Objective: To evaluate the prevalence of brucellosis in the Al-Medina region of Saudi Arabia and to determine the related factors.

Method: A cross-sectional survey was carried out in 1997 with a random multistage cluster sampling of 500 households (4000 subjects). Tube Agglutination Test (TAT) and 2-mercapto-ethanol (2ME) analyzed blood samples.

Result: The study revealed that the prevalence of brucellosis was 2.6%. The prevalence was shown to increase with age in rural communities and low socio-economic status. There are eight predisposing factors associated with brucellosis. These are the consumption of raw milk, and milk products, the keeping of livestock, milking of livestock, animal contact, butchering of raw meat, handling parturient animal and contact with placenta membrane. The overall prevalence of brucellosis among livestock as assessed by examining blood from a random sample of animals was estimated at 17.4%.

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Conclusion: The findings of this work indicate that: (1) There is high prevalence of brucellosis in the Al-Medina region of Saudi Arabia. (2) Very little is being done to prevent or minimize infections. (3) Control and prevention of brucellosis in animals and humans should be the goal in Saudi Arabia

Recommendations: It is recommended that: (1) the surveillance be strengthened; (2) there be strict adherence to hygienic practices on farms; (3) there be cooperation and joint supervision at the boundaries with neighboring countries; (4) there be health education.

Key Words: Prevalence, Brucellosis, Al-Medina region, Saudi Arabia

INTRODUCTION

Brucellosis is an animal infection, which can be directly or indirectly transmitted to man and continues to be a zoonosis of worldwide public health and economic importance.¹⁻⁵ A few epidemiological investigations conducted in the Middle East demonstrated a widespread distribution of brucellosis in the region.⁶⁻¹⁵ Although sporadic human cases of brucellosis were reported during the previous three decades in Saudi Arabia, it was not until the early 1980s that the disease became recognized as a major health problem.⁷

The purpose of this paper is to highlight the epidemiological, clinical and laboratory findings on brucellosis in the Al-Medina region of Saudi Arabia and to determine its related factors.

MATERIALS AND METHOD

Study population: Covering 0.4 million Km², and located in the western part of the Arabian peninsula, the Al-Medina region of Saudi Arabia has an estimated population of 1.4 million people, almost equally distributed in rural and urban areas. About 10% of this population have a nomadic lifestyle and live in tent settlements.

Sample size: The estimated sample size was based on an equal distribution of both sexes and the assumption that the

prevalence of brucellosis was similar to that of other regions (e.g. approximately 1%, Al-Sekait 1992). A simple random sample of 500 households (0.2% of the total population) was needed to estimate the prevalence rate, at a value of 95% confidence.

Sampling strategy: A cross-sectional survey was carried out in the Al-Medina region of Saudi Arabia in 1997 (January until October) with a random multistage cluster sampling of 500 households (4000 subjects).

The sampling method used was in proportion to the population size (PPS) with cluster sampling and urban rural stratification. The procedure was organized as follows: (1) The Al-Medina region was divided into urban and rural areas; (2) Five towns and ten villages were randomly selected; (3) Maps and towns and villages randomly selected were obtained and depending on the population density, one to several primary segments of 100 houses were chosen in a random procedure (second-stage sampling); (4) Twenty houses were randomly drawn from each primary segment that had been randomly selected (third stage sampling). In each selected household all members were surveyed and followed up for four weeks. Out of 4000 residents, 3917 (98%) were clinically examined.

Data collection (the interview): There were four medical teams, each consisting of a general practitioner, two nurses and one laboratory technician. The information was

collected through personal interviews conducted by a trained field team who also performed repeat examinations of 10% of the sample size to ensure a high consistency and reliability. The questionnaire recorded the following information for every subject: age, sex, nationality, residence, educational level, occupation, type of housing, history of previous brucellosis, whether they drank raw milk, consumed milk products, had contact with livestock, milked the livestock, butchered raw meat, handled parturient animal, and had contact with placenta membrane. Thereafter, a clinical examination of each subject was done.

Laboratory methods: Blood samples were obtained from each subject on three different occasions by venesection. The first blood sample was taken at the time of surveying and the remaining two within two weeks thereafter. The Brucellar antibody test was performed by tube agglutination (TAT) for each subject at the time of the survey. If the initial tests were negative, they were repeated after 4 weeks. Sera were tested at two-fold dilution using suspension of *Brucella melitensis* (Wellcome Laboratories, England). Tube agglutination titers less than 1:80 were repeated and considered positive only if a four-fold rise was obtained. It is believed that the use of tube agglutination technique is a sufficient indication of the prevalence of brucellosis, since its results are almost the same as ELISA in the diagnosis of the acute brucellosis.¹⁶

In addition, 2-Mercaptoethanol (2ME), which gives strong evidence against the diagnosis of chronic brucellosis, was used (WHO, 1981). For bacteriological isolation of brucella organism, blood cultures using tryptic soy broth and CO₂ under vacuum (Difco Laboratories) were used. Standard methods for incubation,

subcultures, bacterial identification and antibiotic sensitivity testing procedures were employed.

The blood samples were collected from 2090 livestock (754 sheep, 876 goats, 218 cows and 242 camels), which were being raised in the backyards of the selected households in Al-Medina region. The serum samples were serologically tested for the brucella specific agglutinins using the rose Bengal antigen for the rapid plate-screening test. Samples that gave positive results were confirmed by the standard plate agglutination procedure.¹ The antigen for this test was obtained from FAO/WHO Brucellosis Center, England. Agglutination at 1:50 or greater was considered positive in sheep and goat and camels, but 1:100 or more was classified as positive in cows.¹⁸⁻²⁰

Diagnosis: Definitive diagnosis of brucellosis is difficult. The disease is a combination of clinical and serological features. The serological tests suggest the diagnosis in most cases. In endemic areas, antibodies are present in approximately 20% of the rural population.^{8,10} A diagnosis of brucellosis in humans is made on one or more of the following criteria: (1) A titer (TAT) of at least 1:160 in addition to signs and symptoms is accepted as a case of brucellosis; (2) Isolation of brucella species; (3) A four-fold rise in titers over a four-week period; (4) A titer of at least 1:40 in 2ME in addition to signs and symptoms is considered a case of brucellosis.

Statistical analysis: The statistical analysis of the data was made by using the Statistical Package for Social Science (SPSS) to determine the prevalence and pattern of brucellosis by the factors associated with it. Predisposing factors together with their 95% confidence intervals (CI) were computed and when appropriate tested for a trend. Potential confounding factors were also controlled individually using stratification and the Mantel-Haenzel procedure.²¹

RESULTS

Overall prevalence of Brucella in human: A total of 3917 subjects were examined, 1332 (34%) of whom live in rural areas, and 2585 (66%) in urban areas. There were 102 confirmed cases of brucellosis, making the prevalence rate 2.6% in the Al-Medina region.

Prevalence of Brucellosis in livestock: The principal livestock raised in this part of Saudi Arabia, were goats, sheep and camels. Table 1 shows the number of different animal species studied for the presence of Brucella agglutinins and the distribution of positive reactors. Among the 2090 blood samples tested, 17.4% showed positive titer.

Table 1: Prevalence of brucellosis among livestock in the Al-Medina region as determined by the Plate Agglutination Test (in the year 1997)

Type of animal	Number examined	Positively in animal No (%)
Camel	242	55 (22.7)
Cow	218	18 (8.3)
Goat	876	176 (20.1)
Sheep	754	115 (15.3)
Total	2,090	364 (17.4)

Laboratory findings: A total of 3917 of blood samples were collected, 1688 (43.1%) of which gave positive tube agglutination technique (TAT) at titers ranging from 1:20 to 1:10, 240. The overall high sero-positivity rate (at 80 and above) was 18% of the total of 3917 people from whom blood was taken. Twenty-four percent of those in the rural areas had brucella antibodies at titer of 80 and above, while only 13% of those in the urban areas had antibodies of these levels titer. In addition to signs and symptoms, the sera from 82 (2.1%) of the cases gave TAT reactions at titers ranging from 1:160 to 1:10, 240. Samples from 15 positive cases showed a four-fold or greater rise in

titer (TAT 1:160 – 1:1,560), five cases had converted from negative (TAT less than 1:80) to positive (TAT more than 1:160).

Only 30 cases of the total number of individuals examined had positive blood cultures. If only the 102 serologically positive subjects are considered, the overall positive culture rate would be 29.4%. No individual in our study proved positive for Brucella by blood cultures and negative for agglutinins to Brucella. All 30 Brucella isolates recovered were identified as Brucella melitenis biotype 3. In addition, all the isolates were sensitive to rifampicin, gentamicin, tetracycline, streptomycin, chloramphenicol, cephalothin, sulphamethoxazole and trimethoprim.

Characteristics of patients: Of the 102 cases, no significant gender difference was observed. The prevalence of brucellosis increased significantly with age ($p<0.0001$), significantly ($p<0.0001$) higher in rural areas compared to the urban areas (4.4% vs. 1.7%) and also significantly ($p<0.01$) higher in people of low socio-economic status (semi-

Table 2: Demographic factors associated with brucellosis in Al-Medina region

Variable	Total No. of sample	Cases No. (%)	Relative Odd (95% CI)
Entire sample	3917	102 (2.6)	
Age:			
0	1209	11 (0.9)	1*
15	1169	35 (3.0)	3.3 (1.9-4)
30	867	31 (3.6)	4.0 (2.1-6)
Sex:			
Male	2021	54 (2.7)	1*
Female	1896	48 (2.5)	1 (0.8-1.2)
Residence:			
Urban	2585	43 (1.7)	1*
Rural	1332	59 (4.4)	2. (2.3-3.2)
Social:			
Professional	305	1 (0.3)	1*
Intermediate	871	12 (1.4)	4.7 (1.2-6.3)
Skilled	1148	20 (1.8)	6 (3.9-8)
Semi-skilled	856	36 (4.2)	14 (12.3-15.8)
Unskilled	737	33 (4.4)	14.6 (12.6-15.9)

*Reference

Table 3: Distribution of clinical manifestations among 102 cases with brucellosis in Al-Medina region, Saudi Arabia

Clinical manifestation	No. (%)
Symptoms:	
Fever	72 (70.6)
Sweat	29 (28.4)
Headache	28 (27.5)
Chills	26 (25.5)
Weight-loss	10 (9.8)
Gastrointestinal symptoms	19 (17.6)
Respiratory symptoms	15 (14.7)
Musculoskeletal symptoms:	
Arthralgia	32 (31.4)
Backache	21 (20.6)
Myalgia	12 (11.8)
Lethargy	11 (10.8)
Signs:	
Hepatomegaly	7 (6.9)
Splenomegaly	6 (5.9)
Hepatosplenomegaly	3 (2.9)
Lymphadenopathy	1 (1)

Table 4: Risk factors associated with brucellosis in Al-Medina region

Variable	Sample	Total positive cases No (%)	Relative Odd (95% CI)
Drinking raw milk	663	50 (7.5)	4.4 (2.8-5.7)
Consumption of milk product	321	19 (5.9)	2.4 (1.3-3.4)
Animal contact	267	38 (14.2)	7.3 (5.2-9.6)
Milking animal	167	13 (7.8)	3.2 (2.3-4.1)
Breeding animal	83	10 (12)	5.0 (3.9-6.2)
Parturient animal	75	19 (25.3)	11.7 (9.8-12.7)
Contact membrane placenta	36	11 (30.6)	13.1 (12.2-14.9)
Cutting raw meat	248	16 (6.5)	2.7 (2.3-3.2)

skilled or unskilled laborers) as compared to those of high socio-economic status (professional - 4.4% vs. 0.3%) (Table 2). The commonest symptoms and signs among the 102 cases are summarized in Table 3. Fever was the common symptom (71%). Of the total number of positive cases 31%, 28%, 27%, 25%, 20%, 12% and 11% respectively suffered from arthralgia, sweating, headache, chills, backache, myalgia and lethargy. Seventeen percent of the cases showed enlargement of abdominal organs, including 7 cases of hepatomegaly, six cases of splenomegaly, 3 cases of hepatosplenomegaly and 1 case with lymphadenopathy.

Source of infection: There were 8 pre-disposing factors associated significantly ($p < 0.05$) with brucellosis. These were drinking raw milk, consumption of milk products, keeping livestock, milking of the livestock, butchering of meat, handling parturient animal, animal contact with placenta membrane (Table 4).

DISCUSSION

The results of this study show that brucellosis is a major health problem in the Al-Medina region, Saudi Arabia. The overall prevalence rate of brucellosis was found to be 2.6%. This rate is similar to Al-Sekait's finding from Northern Region (1.7%), Al-Balla's finding from Southern region (2.3%) and Al-Mofleh's finding in Central Region (2.5%) of Saudi Arabia,^{6,9,10} but higher than those reported from the Middle East¹²⁻¹⁴ or other developing countries²²⁻²³ and developed countries.²⁴⁻²⁷

In this study, we found that the prevalence of brucellosis increased with age and agreed with the rates cited in other reports.⁶⁻¹² The relatively low prevalence found in children (less than 15 years) compared with adults may be the result of raw milk consumption and close contact with livestock. In children, morbidity depended largely on the pathogenicity of the infecting *Brucella* species.^{28,29} In contrast to other studies, we

found no significant difference in the prevalence between male and females in all age groups, for they were almost equally susceptible to the infection. This may be because both sexes had close contact with animals. Animal shelters are close to human dwellings and the women of this region are just as involved in animal care as men. The widespread habit of drinking raw milk may also diminish any difference in exposure to the disease between the sexes.

The presenting symptoms and the clinical manifestation in our study are similar to those reported elsewhere,^{26,30} the rheumatological findings being second only to fever in the clinical picture of our cases. The prevalence of arthralgia or arthritis in the present study is the same as observed in recent studies.⁶⁻¹² The rate of detection of visceromegaly was lower than that reported elsewhere.⁸⁻¹⁰ A variety of complications were observed in human brucellosis, but no cases with neurological disturbance or psychiatric manifestation were discovered.

The results of this study indicate that the acquisition of *Brucella* in these individuals may have been through either the contact with infected animals (Odds ratio = 7.3) or through the drinking of raw milk (O.R. = 4.4), or through consumption of milk products (O.R. = 11.7) or through butchering of meat (O.R. = 2.7). Furthermore, the disease occurred mainly among people living in rural areas and in occupations related to livestock rearing and milk production. In consonance with several reports⁶⁻¹⁰ it was found that an important source of infection in urban areas is dairy products.

The endemicity of brucellosis in sheep and goats in Saudi Arabia has been observed since 1983; the infection rate in sheep and goats having been reported as in excess of 20%.^{31,32} The overall prevalence

of brucellosis among livestock tested in this study was 17.4%. Al-Mezaini et al (1984), reported an animal infection rate of 26.1% in the Qassim and Riyadh regions, while Radwan et al reported 14.2% in the Eastern region. The reduction of human cases of brucellosis in the developed countries has been attributed to an eradication program among livestock introduced by governments.^{34,35} There are no such programs in Saudi Arabia and other developing countries. Due to the large number of rural population who raise goats, sheep and camels and who are widely dispersed in remote inaccessible parts of the country where transportation and other modern means are lacking, an eradication programme of brucellosis is hard to implement.

Saudi Arabia now has one of the highest prevalence of brucellosis, involving all age groups and all sections of the community in the region. At present, very little is being done to prevent or minimize infection resulting from contact with infected animals or the consumption of unpasteurized dairy products. Our goal in Saudi Arabia should be the reduction of morbidity and economic loss, through the control and prevention of brucellosis in animals and humans. Practical control measures include the following:

- a. Strict adherence to hygienic measures and practices on the farm.
- b. Avoidance of raw milk until regular screening services can be provided.
- c. Strengthening of the surveillance of brucellosis in population at risk.
- d. Cooperation and joint supervision and surveillance at borders with neighboring countries to control brucellosis in shared grazed area.
- e. Introducing a public health education program on the transmission of the disease.
- f. The adoption of a policy of disposal of infected animals.

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